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(54) **HEAD-MOUNTED MATRIX DISPLAY**

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Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(51) **Int. Cl.**[7] **G09G 5/00**

(52) **U.S. Cl.** **345/8**; 345/7; 345/87; 345/102

(58) **Field of Search** 345/8, 7, 4, 5, 345/6, 87, 102, 76, 82, 905, 903; 348/794, 790, 800, 801; 351/158; 349/61, 62, 64

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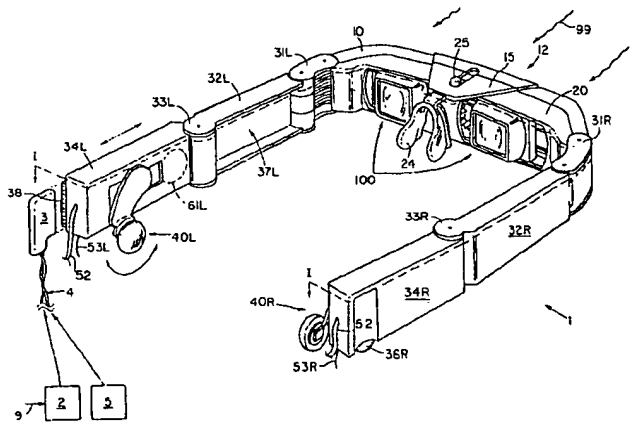
(57) **ABSTRACT**

A compact, light weight head mounted display in which a pair of matrix display elements are mounted within a housing. The display utilizes a pair of arms or stems that are rotatable mounted to the housing such that the user can pivot each arm from a folded position into an open position. The arms can be spring mounted onto the housing to secure the display to the user's head and can also incorporate earphones that can be retracted into each arm when not in use.

44 Claims, 7 Drawing Sheets



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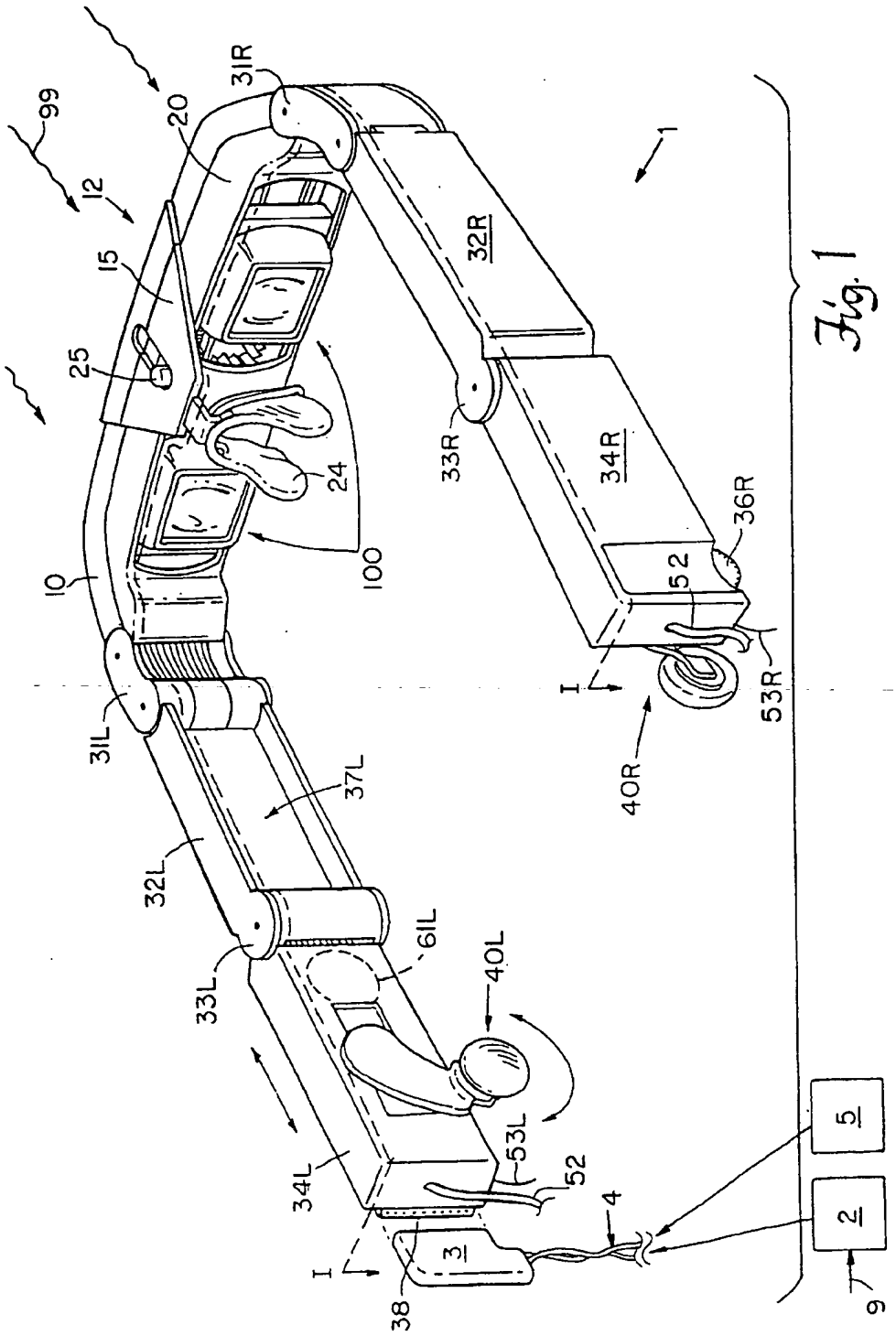
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4
38
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2
5
9
1
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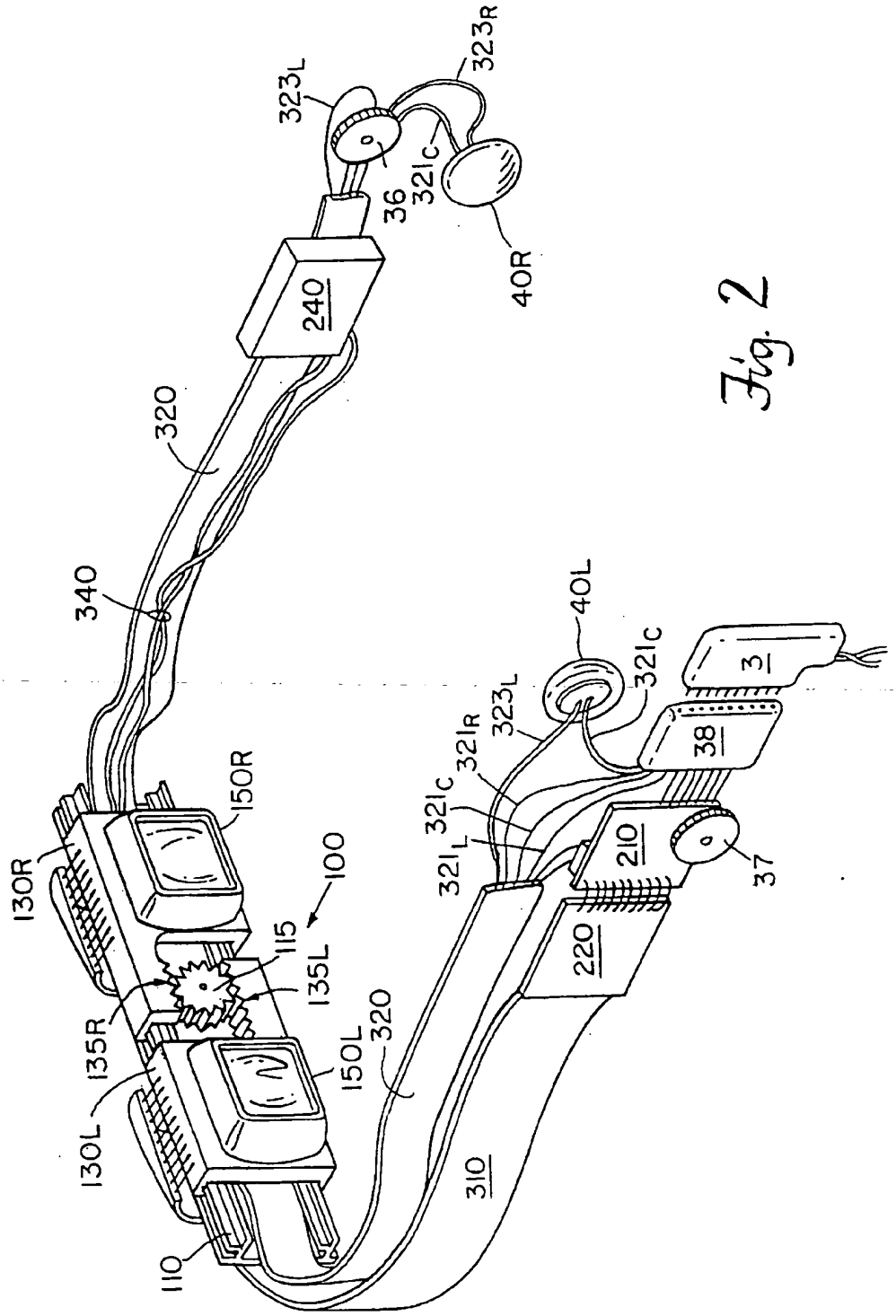
33R
34R
36R
52
53R
40R
I

Fig. 1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323R
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320
340
40L
321C
3
323L
321R
38
321C
321L
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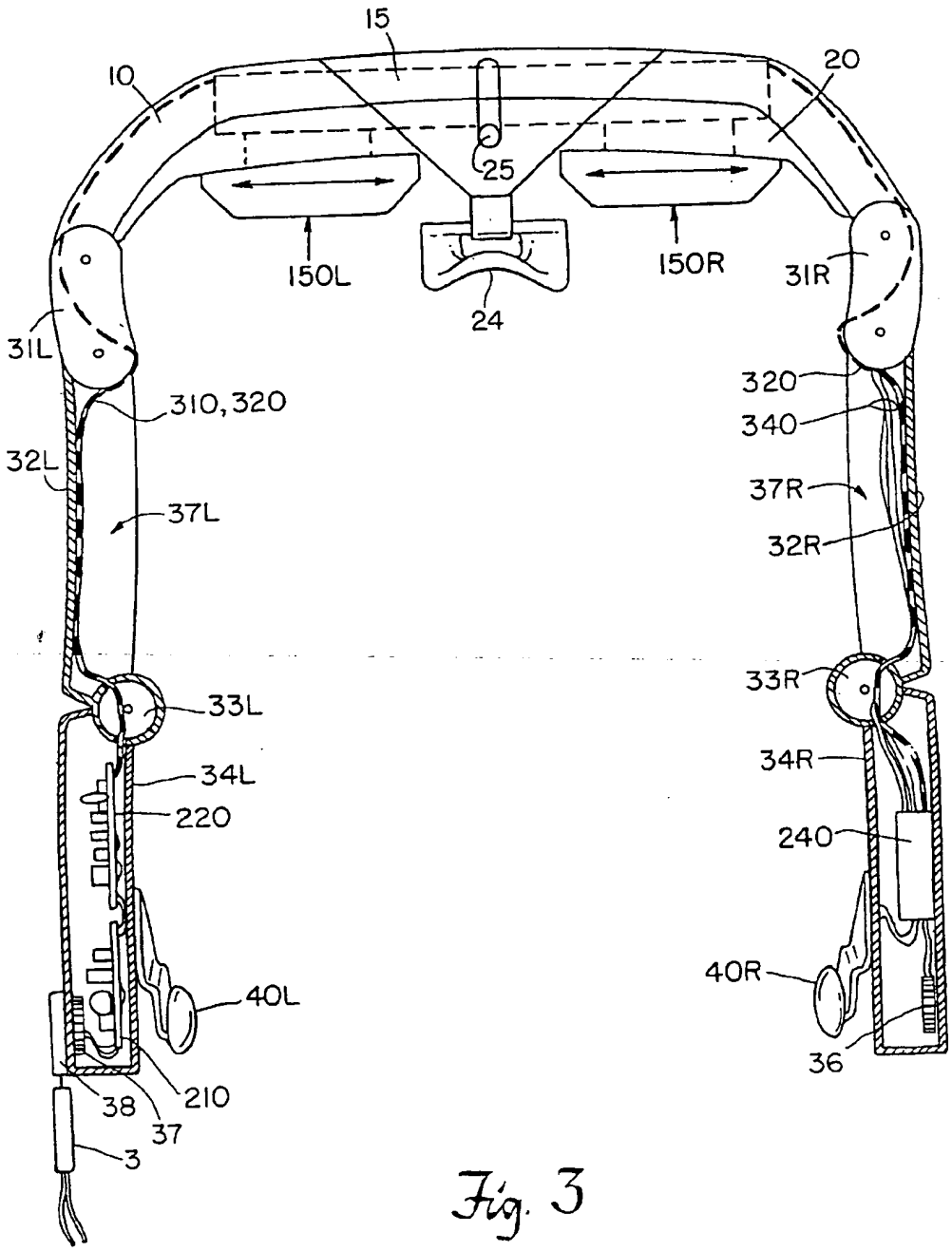
150R
130R
100
115
135L
220
135R
150L
320
130L
310
110

Fig. 2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34R
220
240
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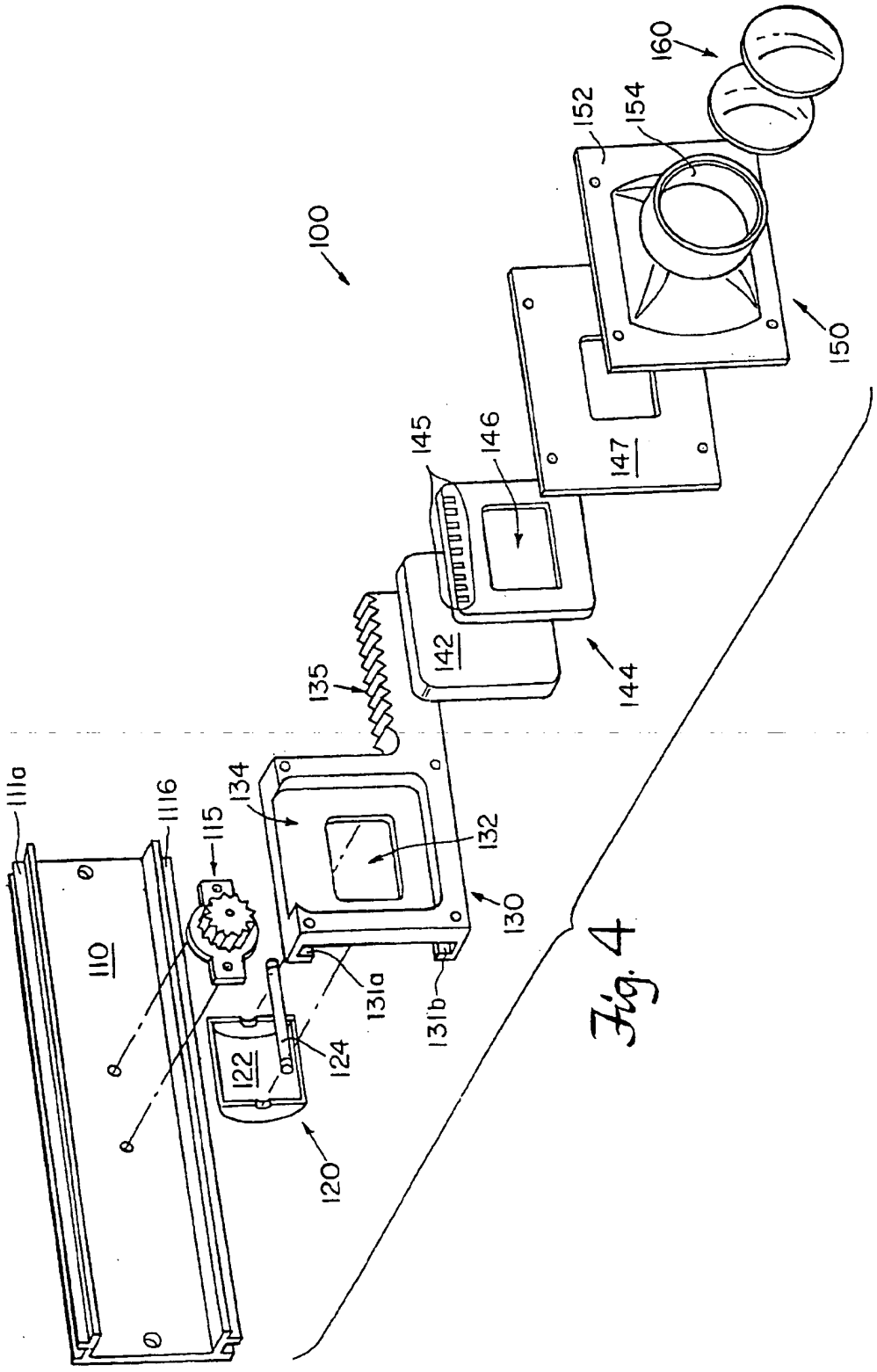
40R
36
38
37
210
3

Fig. 3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132
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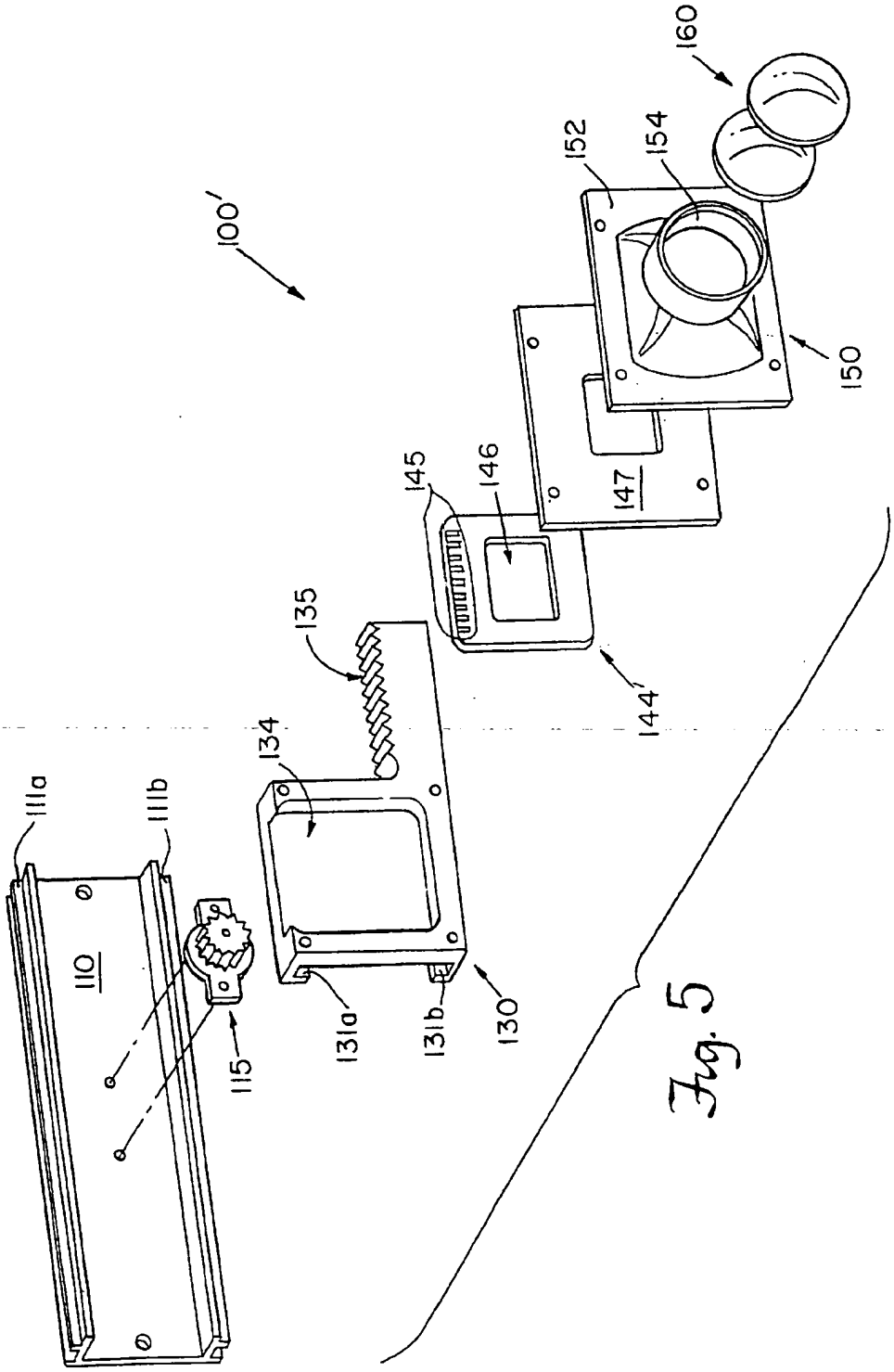
116
115
110
131a
131b
124
122
120

Fig. 4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152
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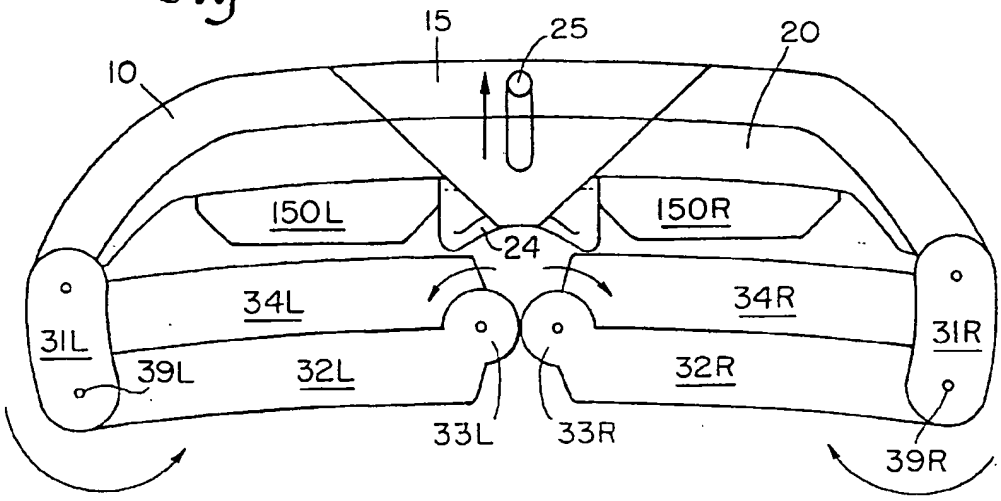
111a
111b
110
131a
131b
130
115

Fig. 5

Fig 6



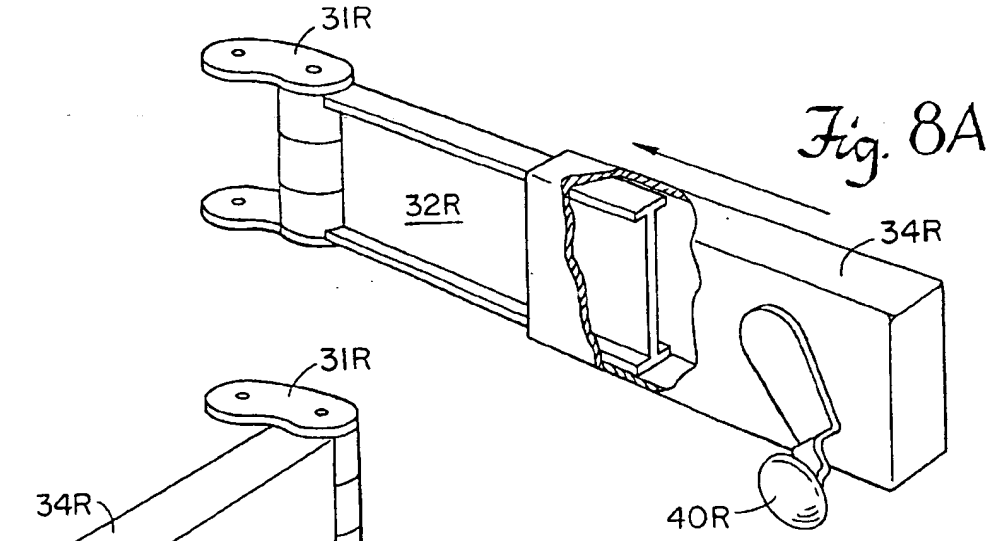


Fig. 8A

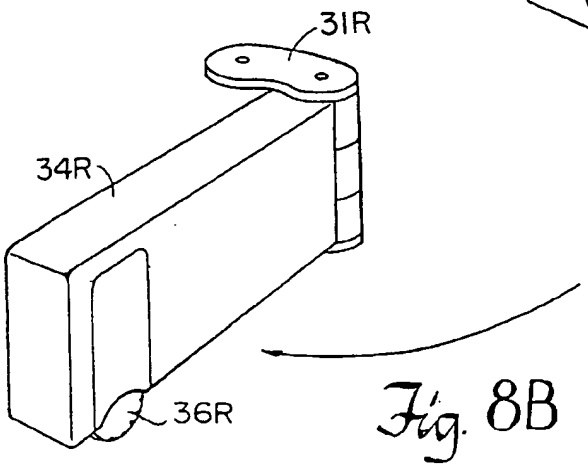


Fig. 8B

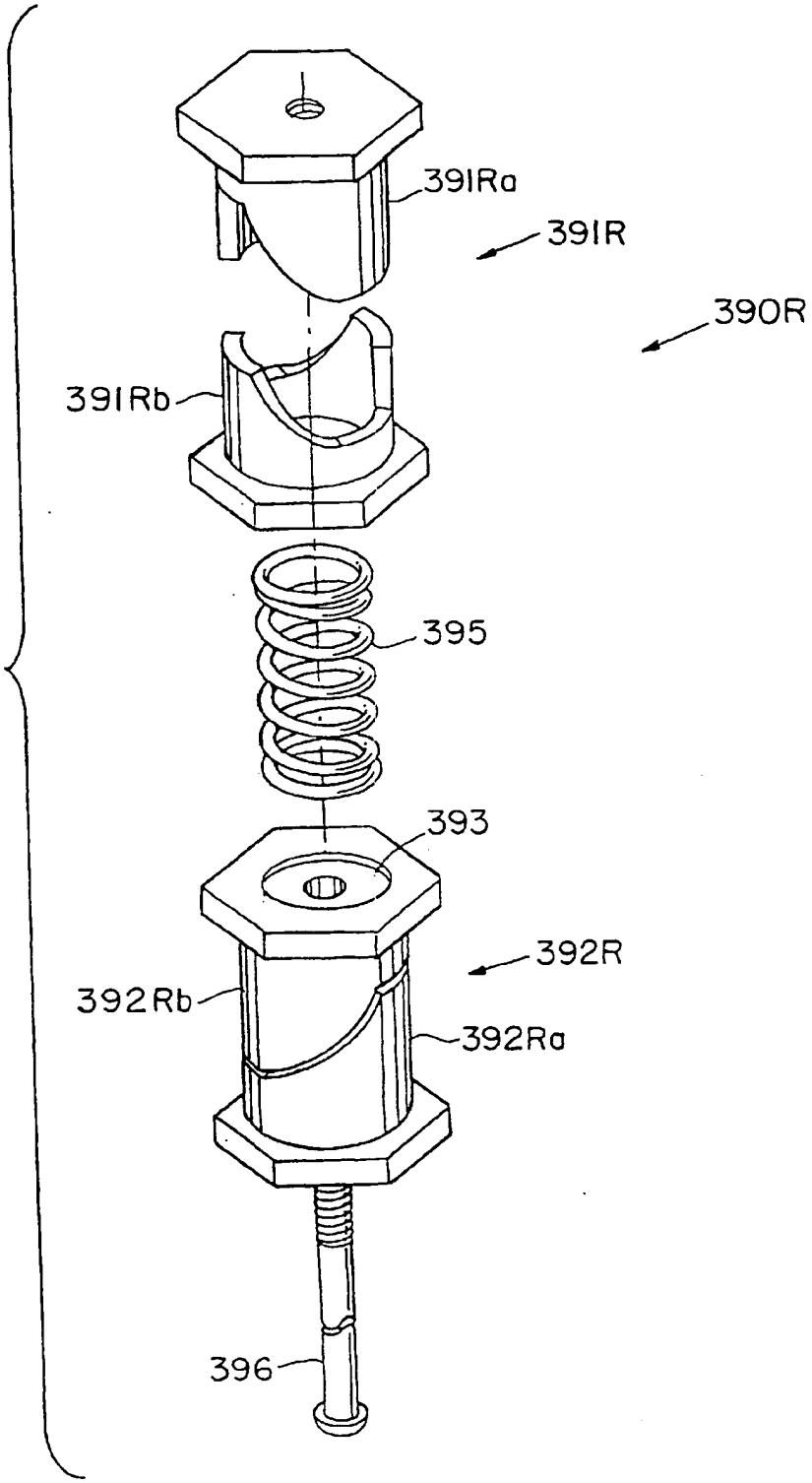


Fig. 7

HEAD-MOUNTED MATRIX DISPLAY

This application is a continuation of application Ser. No. 08/141,133 filed on Oct. 22, 1993, now abandoned, which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

Head mounted display systems have been developed for a number of different applications including use by aircraft pilots and for simulation such as virtual imaging. Head mounted displays are generally limited by their resolution and by their size and weight.

Existing displays have relatively low resolution, and because of the size and weight of available systems, these displays are positioned at the relatively large distance from the eye. Of particular importance, it is desired to keep the center of gravity of the display from extending upward and forward from the center of gravity of the head and neck of the wearer, where it will place a large torque on the wearer's neck and may bump into other instruments during use.

There is a continuing need to present images to the wearer of a helmet mounted display in high-resolution format similar to that of a computer monitor. The display needs to be as non-intrusive as possible, leading to the need for lightweight and compact system. Existing head mounted displays have used analog cathode ray tube ("CRT") devices mounted above or to the side of the user's head which project an image onto a surface or visor mounted in front of the user's eyes. Often these displays utilize helmets which incorporate earphones into the helmet. Other head mounted display devices have contemplated the use of liquid crystal devices that could be mounted above or to the side of the user's head and employ reflective optics to direct an image within the field of view of the user.

SUMMARY OF THE INVENTION

In accordance with the present invention a head mounted display includes a housing in which a pair of matrix display elements are secured. These display elements are of a sufficiently light-weight and compact nature that the housing can be mounted onto the head of a user with a pair of hinge mounted arms or support elements that can be rotated relative to the housing from a closed position to an open position. When in the open position the arms extend about the opposite side of the user's head and serve to position audio transducers mounted on the arms into proximity with the ears of the user. The arms can also be double hinged in which each arm is folded once about its mid-point and then rotated about the hinge on each side of the housing to assume the closed position. System electronics and manually adjustable controls can be positioned within the housing or the rotating arms. Positioning of the electronics and controls within the arms permits a more desirable distribution of weight evenly about the sides of the user's head.

The inter-pupillary distance between the two displays can be adjusted such as by the use of a gear driven cam assembly mounted within the housing.

The direct view display can be a transmission type display with the light source directly adjacent the light valve active matrix and mounted within the display device. The transmission type display can, in a preferred embodiment, also receive light directly from the user's environment so that the display overlays an image over the users existing field of view.

Alternatively, the display can be an emission type device such as an active matrix electroluminescent display or an active matrix of light emitting diodes (LEDs), or a transmissive passive matrix display.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features of the invention, including various novel details of construction and combinations of parts, will now be more particularly described with reference to the accompanying drawings and pointed out in the claims. It will be understood that the particular head mounted display embodying the invention is shown by way of illustration only and not as a limitation of the invention. The principles and features of this invention may be employed in varied and numerous embodiments without departing from the scope of the invention.

FIG. **1** is a rear perspective view of a preferred embodiment of the invention.

FIG. **2** is a perspective view of a preferred embodiment of a wiring harness.

FIG. **3** is a top plan view of the preferred embodiment of FIG. **1** showing the placement of the wiring harness of FIG. **2**.

FIG. **4** is an exploded view of an optical assembly for use in a transmissive display system.

FIG. **5** is an exploded view of a preferred embodiment of an optical assembly for use in an emissive display system.

FIG. **6** is a top plan view showing the embodiment of FIG. **1** in a stowed position.

FIG. **7** is an exploded perspective view of a preferred embodiment of cam assembly for the pivot point **39** of FIG. **6**.

FIGS. **8A–8B** are partial perspective views of another preferred embodiment for storing the stems **30** of FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

FIG. **1** is a rear perspective view of a preferred embodiment of a head mounted display **1**. The head mounted display **1** is constructed of plastic or some other light-weight housing material and is adapted to be worn by a user to view video images via an optical assembly **100**. The head mounted display exploits electronic digital imaging to form video images on a pair of light valve display panels, one of which is viewed through the user's left eye and the other of which is viewed through the user's right eye. Related discussions of head mounted display devices are provided in U.S. patent application Ser. No. 07/971,352, filed Nov. 4, 1992 and International Patent Publication WO 93/18428, filed Mar. 12, 1992, the teachings of which are both incorporated herein by reference.

The images are provided by a remote video source **2**, which can be a comera, a computer, a receiver, a video cassette player, or any device that can transmit a video signal. The video source **2** may generate of video signal from data received over a link **9**, such as fiber optic cable. In addition, supply voltage is provided to the head mounted display **1** from a power supply **5**, which can provide the required supply voltage through the video source **2**. The video source **2** can also provide an audio signal. In a particular preferred embodiment of the invention, the video source **2** and the power supply **5** are physically connected to the head mounted display **1** using a connector **3**.

It should be understood that the head mounted display **1** can be self-contained such that no physical connection to the

remote video source **2** or power supply **5** is required. For example, the head mounted display **1** can contain a receiver to receive transmitted video information and translate that received video information to control signals. Such an embodiment is particularly useful for receiving an over-the-air television broadcast. Similarly, the power supply for the head mounted display **1** can be provided by batteries or another power source (e.g., solar cells) that are integrated into the head mounted display **1**.

The head mounted display **1** has a central housing body **12** that is formed from a front housing section **10** and a back housing section **20**. The front section **10** is preferably formed from an opaque material such as plastic to block external light **99** from the user's eye's. The rear section **20** is also formed from an opaque material but is adapted to permit the user to adjust the optical assembly **100**. The front section **10** is used to mount the optical assembly **100** (FIG. **3**). In addition to the optical assembly **100**, the user can also adjust a nose bridge assembly **24**. The nose bridge assembly **24** can be positioned between an extended position (as illustrated) and a retracted position using an actuating button **25**. The user can select a position from a discrete number of detents. In a preferred embodiment of the invention, the actuating button **25** is fastened to one end of a member that slides within a channel of a support member **15**. The opposite end of the member is fastened to the nose bridge assembly **24**. When in a selected position, the button is registered to a respective detent. The actuating button **25** is pushed to release the button **25** from the detent so that the nose bridge **24** is retracted.

Attached to each side of the head mounted display body **12** is a stem **30** through a respective forward hinge **31**. Each stem contains a forward stem section **32**, which is coupled to the forward hinge **31** at the proximal end. In a particular preferred embodiment, the forward stem section **32** contains a rear hinge **33** at the distal end and an earphone storage compartment **37** into which earphones **40** are stowed when the stems are folded.

Rearward stem sections **34** are coupled to the forward stem section **32** joints **33** at their proximal ends. The rearward stem sections **34** are adapted to supply earphones for use by the user. The earphones **40** pivot down from a horizontally aligned position for use by the user. When stowed, the earphones **40** are returned to a horizontally aligned position for storage in the earphone storage compartment **37** of the forward stem section **32**. The earphones also slide forward and rearward for adjustment by the user. The rear stem sections **34** also contain control knobs **36, 37** (not shown) for adjusting the audio and video features during the operation of the head mounted display **1**. The control knobs **36,37** are thus coupled to electronic circuitry, which is also stored within the stem sections **30**. In a particular preferred embodiment of the invention, the right rear stem section **34R** contains a volume control **36** and the left rear stem section **34L** contains a contrast control **37** (not shown). Also in a particular preferred embodiment of the invention, the left rear stem section **34L** contains a female connector **38** for interfacing with the video source **2** through the male connector **3**. Alternatively, an antenna can be provided to receive audio and video signals.

The head mounted display **1** can be used in numerous and varied applications including, but not limited to, commercial audio/video presentations (television, home video), computer and multimedia presentations, hospital operating room use (e.g. orthoscopic surgery), remote camera monitoring, or any other use where private or detailed viewing of a video image is desired. For certain applications, it is desirable that the body **12** of the head mounted display **1** pivot upward like a visor to permit the user to easily alternate viewing the video image and alive scene. An example of such an application is when the head mounted display **1** is worn by a surgeon during orthoscopic, or other, surgery.

FIG. **2** is a rear perspective illustration of the wiring harness enclosed by the head mounted display **1**. In a particular preferred embodiment, audio and video information and supply power is provided via a 10-pin male connector **3**. The male connector **3** registers to a 10-pin female connector **38**. Of these ten pins, seven pins are provided for the display panel power and backlight power, and three pins are provided for audio signals. The seven video signals are provided to a first circuit **210**. A contrast control **37** is coupled to the first circuit **210** to permit the user to adjust the contrast of the images displayed on the light valve display panels. In other preferred embodiments, other video controls (e.g., brightness, image alignment, color adjust, etc.) are provided and coupled to the first circuit **210**. The first circuit **210** is coupled to a second circuit **220**, which drives the light valve display panels via an N-conductor ribbon cable **310**, where the number of conductors N is determined by the type of display panel.

The first circuit **210** also separates the backlight power signals from the light valve display panel signals and provides those signals to a backlight driver **240** over a 6-conductor ribbon cable **320**. In addition to the two backlight driver signals, the 6-conductor ribbon cable **320** carries four audio signals. A left channel signal $\mathbf{321}_L$, a common signal $\mathbf{321}_c$, and a right channel signal $\mathbf{321}_R$ are provided on the 6-conductor ribbon cable **320** to a stereo volume control **36**. In a particular preferred embodiment, the backlight driver **240** and the stereo volume control **36** are disposed within the opposite stem **30** from the circuit **210**.

The stereo volume control **36** permits the user to alter the gain of the signals in the right and left earphones **40**. The adjusted right signal $\mathbf{321}_R$ is provided to the right earphone **40R** and the adjusted left channel signal $\mathbf{323}_L$ is carried by the 6-conductor ribbon cable **320** back to the left earphone **40L**. Both the left and right earphone are also provided with the common signal $\mathbf{321}_c$. In other preferred embodiments, other audio controls (e.g., stereo balance, tone, etc.) are provided.

The second circuit **220** need not be a discrete device as illustrated; In another preferred embodiment, the second circuit **220** is fabricated with each display panel, such that each display panel is controlled by a respective control circuit.

The backlight driver **240** provides high voltage signals to the optical assembly **100** over signal lines **340**. The high voltage signals can be used to drive a backlight for each display panel where a transmissive display panel is used. Similarly, the high voltage supply can be used to drive an emissive display panel. In a particular preferred embodiment of the invention, the display panels are of the active matrix liquid crystal display type, which require backlighting.

In a preferred embodiment the discrete circuiting **38, 210, 220, 240** are disposed near the rear of the head mounted display **1** to provide for more even weight distribution. A preferred control circuit for driving the active matrix display panel **13** is described in U.S. patent application Ser. No. 07/971,399, filed Nov. 4, 1992, the teachings of which are incorporated herein by reference. In another preferred embodiment, the display panels are of the passive matrix liquid crystal display type. A control circuit for driving the passive matrix display panel is discribed in U.S. patent

application Ser. No. 07/971,326, filed Nov. 4, 1992, the teachings of which are incorporated herein by reference.

FIG. **3** is a top plan view of the head mounted display **1** taken along section line I—I of FIG. **1**. The positioning of the wiring harness **300** is illustrated in phantom. Note that the ribbon cables **310**, **320** are routed around the joints **31**, **33** to permit folding of the stems **30** into a compact unit for storage. In a preferred embodiment, the rear hinge **33** employs a split cylinder that rotates independent of the joint so the ribbon cable is not visible when the stems are opened or folded.

FIG. **4** is an exploded view of the optical assembly for the head mounted display **1**. A mounting frame **110** is adapted to be mounted to the inner surface of the front section **10** of the head mounted display **1**. The mounting frame **110** has first and second guide rails **111***a*, **111***b* to permit adjustment of the inter-pupil displacement of the light valve display panels. The adjustment of the inter-pupil displacement will be discussed in more detail below.

Mounted to the mounting frame is a backlighting assembly **120** for use in transmissive display systems. The backlighting assembly **120** contains a backlight **124**, which is preferably a cold cathode backlight. The backlight **124** is disposed in a white reflector **122**, which reflects light from the backlight **124** onto the display panel. In a transmissive color display, the backlighting can be provided by a multi-color sequential backlight where there is a backlight for each primary display color (e.g., red, green, blue) and the backlights are sequentially lit in timing with the switching of the light valve. In another preferred embodiment backlight is provided by direct ambient light **99**. Through a light transmissive front housing section **10** and mounting frame **110**.

A display holder **130** is positioned on the mounting frame **110** such that the mounting frame rails **111***a*, **111***b* are disposed within respective display holder channels **131***a*, **131***b*. The display holder **130** contains a display area **134** and an aperture **132** through which light from the backlight **124** passes. The display holder **130** also has a geared rack **135** for use in adjusting the inter-pupil displacement. A viscous damped gear assembly **115** meshes with the geared rack **135** such that rotational motion of the gear assembly **115** causes linear movement of the display holder **130** along the mounting frame **110**. As illustrated, the user adjusts the inter-pupil displacement by sliding the left and right display holders **130** along the mounting frame **110**. Alternatively, an axle can extend from the gate **115** to a knob or crank lever, preferably disposed on the forward face of the front section **10** of the display body **12**. Indicator marking can also be provided to guide the user.

Although only the left portion of the optical assembly **100** is illustrated in FIG. **3**, the right display holder is similar to the left display holder, except that the right display holder is rotated 180° relative to the left display holder. In that alignment, the left display holder gear rack **135L** is positioned below the gear assembly **115** and the right display holder gear rack **135R** is positioned above the gear assembly **115** as illustrated in FIG. **2**. Consequently, the gear assembly simultaneously displaces both the left and right display holders when rotated. In a preferred embodiment of the invention, the inter-pupil displacement is adjustable by the user in a range from about 55 mm to 72 mm to provide an aligned left-right image to the user.

Returning to the optics assembly, a display assembly **140** is registered to the display chamber **134**. The display assembly contains a translucent plastic light diffuser **142**, a liquid crystal display panel **144**, and a thin plastic matte black mask **146**. The diffuser **142** diffuses light from the backlight **124** that passes through the display holder aperture **132** to provide a light distribution that is sufficiently uniform across the display area **147**. The liquid crystal display panel **144** has a display area that is 0.7 inch as measured diagonally. The liquid crystal display panel **144** is preferably fabricated in accordance with U.S. patent Ser. No. 07/815,684, filed Dec. 31, 1991, the teachings of which are incorporated herein by reference. The display panel **144** contains connectors to connect to the 20-conductor ribbon cable **310** (FIG. **2**). The display assembly **140** is secured in the display holder chamber **134** by an optics holder **150**, which is fastened to the display holder **130**. The optics holder **150** contains a housing **152** that may be conformable to the users eye to block ambient light and surround a cover glass **154**.

Optional lenses **160** are adaptable to the display holder **150** to, for example, correct the user's near vision.

Although FIG. **4** illustrates a preferred embodiment employing a transmissive display panel, an optical assembly **100'** can be adapted to receive an emissive display panel **144'**, as illustrated in FIG. **5**. The emissive display optical assembly **100'** differs from the transmissive display optical assembly **100** in the following respects. The emissive embodiment does not use a backlight **120**. Thus the display holder **130** does not require an aperture **132** or a light diffuser **142**. Instead, the light is provided by emissive material on the display panel **144** that is activated by drive signals. The emissive display panel is preferably fabricated in accordance with U.S. patent application Ser. No. 07/643,552, which issued on Apr. 5, 1994 as U.S. Pat. No. 5,360,788, the teachings of which are incorporated herein by reference.

FIG. **6** is a top plan view of the head mounted display **1** in the folded configuration. In particular, note that the nose bridge assembly **24** has been positioned into the retracted position for storage. In the retracted position, the nose bridge assembly **24** does not interfere with the folding of the stems **30**. The hinge points **39** on the forward joints **31** are spring tensioned to facilitate head rotation.

FIG. **7** is an exploded view of a preferred spring cam assembly, **390R** that is used at the hinge port **39R** on the right forward joints **31R**. The cam assembly **390R** comprises a first cam **391R** and a mirror image second cam **392R**. The cams **391R**, **392R** contain an outer section **391Ra**, **392Ra** that registers to a respective receptacle on the body **12** and an inner section **391Rb**, **392Rb** that registers to a respective receptacle on the forward stem **32R**. the inner cams **391Rb**, **392Rb** each include a landing **393** that allows for free play before engagement. A compression spring **395** is disposed between spring landings. The cams **391R**, **392R** compress the spring **395** when rotated together. For the right stem **30R**, free play is exhibited for an angular displacement from the folded position, thereafter a variable return force is extended by the spring **395**, which tends to secure the head mounted display **1** to the user's head. The compression can be adjusted by an adjustment bolt **396** that meshes with a threaded opening on the outer sections **391***a*, **392***b*.

FIGS. **8A–8B** are partial views of another preferred stem storage embodiment. The forward stem section **32** is a skeleton frame on which the rear stem section **34** slides for storage. (FIG. **8B**) Alternatively, the forward stem section **32'** can encapsulate the rear stem section **34'** when stored.

Other preferred embodiments employ other devices to secure the head mounted display, to the user's head. Such devices include an inflatable bladder **51** (shown in phantom in FIG. **1**), with an associated pump assembly, that is disposed over the user's temple, and a headband **52**, and ear loops **53**.

In a preferred embodiment, the head mounted display **1** is formed from injection molded plastic. Particular components, such as the nose bridge support member **15**, are rigid glass filtered molded plastic or a composite laminate.

Equivalents

Those skilled in the art will know, or be able to ascertain using no more than routine experimentation, many equivalents to the specific embodiments of the invention described herein. These and all other equivalents are intended to be encompassed by the following claims.

We claim:

1. A head mounted display device comprising;

a housing for holding a first matrix display and a second matrix display relative to the head of a display user, the housing having a first aperture through which the first matrix display can be viewed and a second aperture through which the second matrix display can be viewed, each matrix display including a backlight source, a light diffuser, an active matrix liquid crystal display and a lens that are aligned along a common linear axis with an eye of a user, each backlight source directing light along each respective common linear axis through a respective diffuser, display and lens;

a mounting frame within the housing such that each matrix display slides relative to the mounting frame to adjust a distance between the first matrix display and the second matrix display;

a first pair of hinge mounted support elements that are both rotatable between respective closed positions and respective open positions such that the pair of support elements can be fitted about the head of the user when both support elements are in the respective open positions; and

a connector mounted on the display device that is connected to the first matrix display and the second matrix display to deliver a video signal from an external video source.

2. The head mounted display device of claim **1** further comprising a second pair of hinge mounted support elements, each being mounted to one of the first pair of hinge mounted support elements.

3. The head mounted display device of claim **1** wherein the first matrix display and the second matrix display are connected to a driver circuit mounted to the housing.

4. The head mounted display device of claim **1** further comprising a spring tension mount which imparts a force tending to move each support element from the open position to the closed position.

5. The head mounted display device of claim **1** further comprising a pair of audio transducers wherein each audio transducer is moveably mounted in a support element.

6. The head mounted display device of claim **1** further comprising a moveable nose bridge mounted on the housing.

7. The head mounted display device of claim **1** wherein the first and second matrix displays have a diagonal display length of about 0.7 inches.

8. The head mounted display device of claim **1** further comprising a flexible sleeve for securing each support element to the user's ear.

9. The head mounted display device of claim **1** further comprising an optical system, the optical system having a first lens positioned between the first matrix display and the first aperture and a second lens positioned between the second matrix display and the second aperture.

10. The head mounted display of claim **1** further comprising a video control circuit mounted within the display device.

11. The head mounted display of claim **10**, further comprising an adjustable controller mounted on the display device to adjust a control signal delivered by the video control circuit to the first and second matrix displays.

12. The head mounted display of claim **1** further comprising a display controller for adjusting a distance between the first matrix display and the second matrix display.

13. The head mounted display device of claim **1** further comprising a reflector mounted adjacent to each backlight source.

14. The head mounted display device of claim **1** wherein the backlight source is a multicolor light source.

15. The head mounted display device of claim **14** wherein the backlight source is sequentially operated to successively generate each color.

16. A head mounted display device comprising;

a housing.for holding a first matrix display and a second matrix display relative to the head of a display user, the first matrix display having a first backlight source directing light through a first light diffuser, the first display and a first lens along a first linear viewing axis to an eye of the user and the second matrix display having a second backlight source directing light through a second light diffuser, the second display and a second lens along a second linear viewing axis to an eye of the user;

a first pair of hinge mounted support elements that are both rotatable between respective closed positions and respective open positions such that the pair of support elements can be fitted about the head of the user when both support elements are in the respective open positions;

a mounting frame within the housing such that each matrix display slides relative to the mounting frame to adjust a distance between the first matrix display and the second matrix display;

a pair of audio transducers, each audio transducer being mounted to one of the hinge mounted support elements such that each transducer can deliver an acoustic signal to an ear of the user; and

a connector mounted on the display device that is connected to the first matrix display and the second matrix display to deliver a video signal from an external video source, the connector being connected to both audio transducers to deliver an audio signal from an external audio source.

17. The head mounted display device of claim **16** wherein the first matrix display and the second matrix display are both active matrix liquid crystal displays.

18. The head mounted display device of claim **16** further comprising a spring tension mount which imparts a force tending to move each support element from the open position against the head of the user.

19. The head mounted display device of claim **16** wherein each audio transducer is moveably mounted in a support element.

20. The head mounted display device of claim **16** further comprising an optical system, the optical system having a first lens positioned adjacent the first matrix display and a second lens positioned adjacent the second matrix display.

21. The head mounted display of claim **16** further comprising a video control circuit mounted within the display device.

22. The head mounted display of claim **21** further comprising a manually adjustable controller mounted on the display device to adjust a control signal delivered by the video control circuit to the first and second matrix displays.

23. The head mounted display of claim 16 further comprising a display controller for adjusting a distance between the first matrix display and the second matrix display.

24. The head mounted display device of claim 16 further comprising a control circuit for controlling the first and second backlight sources.

25. The head mounted display of claim 16 further comprising an audio control circuit mounted within the device and an audio controller to provide manual adjustment of the audio signal.

26. The head mounted display device of claim 16 wherein the backlight source is a multicolor light source.

27. The head mounted display device of claim 26 wherein the backlight source is sequentially operated to successively generate each color.

28. A head mounted display device comprising:

a mounting frame that is stationary relative to the head of a display user;

an active matrix liquid crystal display mounted to a display holder such that the display can be positioned with a lens, the display having a ribbon connector to a display circuit, a backlight source and a light diffuser along a single common linear optical axis extending through the lens to an eye of the user, the backlight source directing light along the common linear optical axis through the light diffuser, the display and the lens to the eye of the user; and

a rail on the mounting frame such that the display holder slides along the rail relative to the stationary frame in a direction transverse to the linear optical axis to laterally position the display relative to the eye of the user.

29. The head mounted display device of claim 28 further comprising an active matrix display driving circuit mounted to the frame.

30. The head mounted display device of claim 28 further comprising a backlight driver circuit mounted to the frame.

31. The head mounted display device of claim 28 further comprising a pair of audio transducers.

32. The head mounted display device of claim 28 wherein the backlight source is a multicolor light source.

33. The head mounted display device of claim 32 wherein the backlight source is sequentially operated to successively generate each color.

34. A head mounted display device comprising:

a mounting frame that is stationary relative to the head of a display user;

an active matrix liquid crystal display panel mounted to a display holder, the display panel having a ribbon connector to a display circuit;

a lens, a backlight source and a light diffuser positioned along a single common linear optical axis extending through the display panel to an eye of the user such that light from the backlight is directed through the light diffuser and the display to form an image that is directed through the lens along the common linear optical axis;

a rail on the mounting frame such that the display holder slides along the rail relative to the stationary frame in a direction transverse to the linear optical axis to position the display relative to the eye of the user; and

an active matrix display driving circuit mounted to the frame.

35. The head mounted display device of claim 34 further comprising a backlight driver circuit mounted to the housing.

36. The head mounted display device of claim 34 further comprising a flexible cable extending from the display holder to the frame to deliver video signals from a connector mounted to the frame to the matrix display.

37. The head mounted display device of 34 wherein the active matrix driving circuit is formed on the active matrix display panel.

38. The head mounted display device of claim 34 wherein the backlight source is a multicolor light source.

39. The head mounted display device of claim 38 wherein the backlight source is sequentially operated to successively generate each color.

40. A head mounted display device comprising:

a housing;

a matrix display carried by the housing and connected to a display circuit;

the housing having an aperture through which the matrix display can be viewed;

a receiver and an antenna for receiving a signal for displaying on the matrix display, the receiver being connected to the display circuit; and

the matrix display including a backlight source, a light diffuser, an active matrix liquid crystal display, and a lens that are aligned along a common linear axis extending to an eye of a user, the backlight source directing light along the common linear axis through the diffuser, the display and the lens.

41. A display device as in claim 40 further comprising a reflector mounted adjacent to the backlight source.

42. The display device as in claim 40 wherein the multicolor light source is red, blue, and green.

43. A display device as in claim 42 wherein the backlight source is sequentially operated to successively generate each color.

44. A method of displaying an image on a matrix display adapted for viewing by a user, comprising the following steps:

providing a housing for holding the matrix display, the housing having an aperture through which the matrix display can be viewed, the matrix display including a red, blue, and green backlight source, a light diffuser, an active matrix liquid crystal display and a lens that are aligned along a common linear axis;

receiving a video signal with a receiver and an antenna;

operating a display control circuit connected to the matrix display to display an image on the display;

simultaneously directing light from the backlight source along the common linear axis through the diffuser, display and lens by operating sequentially a multicolor light source to generate each color; and

aligning the common linear axis with an eye of the user.

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